

**STAGING KNOWLEDGE AND EXPERIENCE:
HOW TO TAKE ADVANTAGE OF REPRESENTATIONAL
TECHNOLOGIES IN EDUCATION AND TRAINING?**



August 28-31, 2012

Laboratoire des Sciences de l'Éducation
Université Pierre-Mendès-France, Grenoble, France

Editors: Erica de Vries & Katharina Scheiter

PREFACE

It is a great pleasure to welcome you at the 2012 EARLI Special Interest Group 2 meeting hosted by the Laboratory of Educational Sciences of the Pierre-Mendès-France University in Grenoble, France. The EARLI SIG 2 is one of the twenty-two special interest groups of the European Association of Learning and Instruction. It focuses on how learning is influenced by the representation of the learning material, such as by way of text and pictures. However, as there is an explosion of new representations by the introduction of graphical interfaces, members of the SIG now consider multiple forms of representation, including, but not limited to, texts, pictures, graphs, diagrams, concept maps, animations, equations, virtual reality, information and scientific visualization, haptics, multimedia, hypermedia, and simulations. The SIG meets every two years, in alternation with the main EARLI conference, in order to establish continuity in collaborations of its members.

The theme of the Grenoble 2012 meeting is “Staging knowledge and experience: How to take advantage of representational technologies in education and training?” The term “staging” is used here to suggest the analogy with the “mise-en-scène”, i.e. the design of the visual aspects, in theatre and film productions. In effect, instructional designers, teachers, and trainers, but also learners themselves, can be thought of as “directors” striving to find an appropriate arrangement – in terms of composition, sets, props, actors, costumes, and lighting – of knowledge and experience to be acquired. As mentioned in the SIG 2 mission statement, this nowadays involves using a whole range of possibilities for external representation, not just texts and pictures, as a kind of semiotic technology for expressing knowledge and displaying skills.

The meeting features three keynotes, a JURE pre-conference workshop, eight paper sessions and a poster session. We received a total of 75 paper and poster submissions by 176 authors from 19 different countries. All submissions were reviewed by the scientific committee of 20 members from 9 different countries. 37 papers and 36 posters were accepted. This volume contains all presented papers and posters. The high number of multiple-author, multiple country contributions shows that the SIG is in good shape and the bi-annual meeting fulfils its function.

We thank the European Association for Research on Learning and Instruction, the Scientific Board of the Pierre-Mendès-France University, the Grenoble Alpes Metropole, the City of Grenoble, and the Rhone-Alpes Region for financial support. Finally, we thank in particular the local committee and members of the Laboratory of Educational Sciences for organizing what we hope will be a very fruitful meeting!

Bienvenue et bon colloque.

Erica de Vries
Katharina Scheiter

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EARLI SIG 2 Meeting Grenoble 2012

Wednesday, August 29, 2012

08.30 – 09.00 Welcome & Registration

09.00 – 09.15 Opening

09.25 – 11.00 Paper session

Chair: Mireille Bétrancourt

Multimedia learning

Judith Schweppe & Ralf Rummer

Long-Term Multimedia Learning

Huib Tabbers & Jacob Diepenhorst

Not Static or Dynamic Media but Navigational Affordances Promote Active Learning

Hector Garcia Rodicio & Emilio Sanchez

A Comparison of Prompts, Corrective Feedback, and Elaborative Feedback in Multimedia Learning

Erlijn van Genuchten, Charlotte van Hooijdonk,
Katharina Scheiter & Anne Schüler

Studying and Executing Procedures: Do Pictures Facilitate Visuo-Spatial Reasoning During Learning?

11.00 – 11.30 Coffee break

11.30 – 12.30 Keynote

Chair: Jean-Michel Boucheix

Nathalie Blanc

The Early Development of Text Comprehension Skills: Emotional Inferences are Relevant Cues

12.30 – 13.30 Lunch

13.30 – 15.30 Paper session

Chair: Ric Lowe

Text comprehension

Isabel Braun & Matthias Nückles

Reading Their Way Into Science: Students' Strategies For Comprehending Research Articles

Carlos Ferreira, Hector Garcia Rodicio, Emilio Sanchez

Signals in Expository Prose, Is the Ability to Recognize and Interpret them Specific of Reading Comprehension?

Lisanne van Weelden, Joost Schilperoord & Alfons Maes

Metaphors Activate Object Shape

Philippe Dessus, Maryse Bianco, Aurélie Nardy,
Françoise Toffa, Mihai Dascalu & Stefan Trausan-Matu

Automated Analysis of Pupils' Self-Explanations of a Narrative Text

Emmelen Merchie & Hilde Van Keer

Effects of a Mind Map Intervention on Fifth and Sixth Graders' Learning from Texts

15.30 – 16.00 Coffee break

16.00 – 17.35 Paper session

Chair: Tina Seufert

New directions

Adriana Alexandra Baltaretu, Alfons Maes & Carel van Wijk

Mere Presence, Object Orientation and Perspective Taking

Richard Lowe

Using Vibration to Guide Exploration of Haptic Graphics

Tinne Dewolf, Wim Van Dooren, Frouke Hermens & Lieven Verschaffel

Students' Eye Movements when Solving Mathematical Word Problems Together with Illustrations

Katharina Scheiter, Jana Arndt, Birgit Imhof & Shaaron Ainsworth

Move Like a Fish: Do Gestures Aid Learning from Photographs and Videos?

17.35 - 19.30 Poster Session & Welcome reception

Thursday, August 30, 2012

09.00 – 11.00 Paper Session

Chair: Huib Tabbers

Abilities and preferences

Mireille Bétrancourt, Shaaron Ainsworth, Erica de Vries, Jean-Michel Boucheix & Richard Lowe

Graphicacy: Do Readers of Science Textbooks Need It?

Jean-Michel Boucheix, Richard Lowe, Shaaron Ainsworth, Mireille Bétrancourt & Erica de Vries

Paired Graphics: An Exploratory Study of Graphicacy

Marije Van Amelsvoort & Hans Westerbeek

Visualizing Football Statistics: Performance and Preference

Annemarie Quispel & Alfons Maes

Visual Ability in Navigation Communication

Sandra Nitz, Claudia Nerdel & Helmut Prechtl

Modelling the Relationship between Representational Competence and Domain Knowledge

11.00 – 11.30 Coffee break

11.30 – 12.30 Keynote

Chair: Katharina Scheiter

Sara Irina Fabrikant

Of Metaphors, Maps, and Methods: Cognitively Inspired and Perceptually Salient Graphic Displays

12.30 – 13.30 Lunch

13.30 – 15.30 Paper Session

Chair: André Tricot

Text-picture integration

Jana Arndt, Anne Schüler & Katharina Scheiter

Examining the Integration of Text and Pictures

Wolfgang Schnotz, Ulrike Hochpoechler, Thorsten Rasch, Mark Ullrich, Holger Horz, Nele McElvany & Jürgen Baumert

Information Access Patterns of Students Working on Text-Picture Integration Tasks

Felix Wagner, David Rudolf & Tina Seufert

Benefits of a Training for Visualizing as a Learning Strategy

Alexander Eitel, Katharina Scheiter, Anne Schüler, Marcus Nyström & Kenneth Holmqvist

How a Picture Can Scaffold Comprehension of Text

Patrik Pluchino, Maria Caterina Tornatora & Lucia Mason

Fourth Graders' Text and Picture Integration in Processing and Learning from Science Text: Evidence from Eye Movement Patterns

15.30 – 16.00 Coffee break

16.00 – 17.35 Paper Session

Chair: Jean-François Rouet

Learning with animations

Stefan Münzer

Animations Facilitate Spatial Perspective Taking

Sandra Berney, Gaëlle Molinari, Nady Hoyek & Mireille Bétrancourt

Using 3D Animation for Learning Functional Anatomy

Irene T, Skuballa, Rolf Schwonke & Alexander Renkl

Visual Attention Guidance in Narrated Animations: Understanding is More Than Just Seeing

Dian Kemala Putri, Jean-Michel Boucheix & Richard K. Lowe

Effects of Simplified Ancillary Representations and Cues on Learning from Animation

17.35 – 18.30 SIG 2 Business meeting

20.00

Dinner

Friday, August 31, 2012

09.00 - 11.00 Paper Session

Chair: Shaaron Ainsworth

Scientific and mathematical representations

Tobias Fredlund, John Airey & Cedric Linder

Critical Aspects of Scientific Phenomena - To the Fore, in the Background, or not Present in Scientific Representations

Stephanie Lem, Patrick Onghena, Lieven Verschaffel & Wim Van Dooren

The Misinterpretation of Box Plots

Victor López Simó & Roser Pintó Cassulleras

Secondary Students' Reading of Digital Visual Representations when Using Physics' Educational Simulations

David Corradi, Jan Elen & Geraldine Clarebout

Limits and Potentials of Bottom-up Processing of Multiple External Chemical Representations

Dominique Bellec, Andre Tricot & Paul Ayres

A Comparison of Different Levels of Interactions when Using the Isolated-Elements Strategy

11.00 - 11.30 Coffee break

11.30 - 12.30 Keynote

Chair: Wolfgang Schnotz

Neil H. Schwartz & Robert W. Danielson

What Kind of Graphic is This? A Framework for Delineating the Graphics in Text-Graphic Research

12.30 - 13.30 Lunch

13.30 - 15.30 Paper Session

Chair: Marije van Amelsvoort

Multiple documents processing

Jean-François Rouet, Christine Ros, Guillaume de Pereyra, Mônica Macedo-Rouet & Ladislao Salmeron

Teenage Students' Awareness of Source Quality when Selecting Web Links

Yvonne Kammerer & Peter Gerjets

The Impact of Discrepancies across Web Pages on High-School Students' Source Trustworthiness Evaluations

Carla Firetto & Peggy Van Meter

The Effect of Task Instruction and Text Overlap on the Integration of Multiple Cross-Domain Sources

Marc Stadtler, Lisa Scharrer & Rainer Bromme

Does Relevance Matter in Comprehending Scientific Conflicts from Multiple Documents? Evidence from Online and Offline-Data

Johanna Maier & Tobias Richter

Effects of Text-Belief Consistency and Reading Goals on the Comprehension of Multiple Science-Related Texts

15.30 Closing

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2.	Madeline Hallewell	<i>What's the Point of Bulletpoints? The use of Text in PowerPoint Lectures</i>
3.	Alexandra König, Mona Stadler, Melina Klepsch & Tina Seufert	<i>The Effects of Visualization Forms on Usability and Learning Outcomes – Dynamic Videos versus Static Pictures</i>
4.	Lena von Kotzebue & Claudia Nerdel	<i>Biology Teachers' Professional Knowledge of Diagrams</i>
5.	Anne Schöler, Katharina Scheiter & Francesca Pazzaglia	<i>What Pictures Are Good For</i>
6.	Jan van der Meij, Hans van der Meij	<i>Dynamic Representations on the Interactive Whiteboard</i>
7.	Richard Lowe, Jean-Michel Boucheix	<i>Addressing Challenges of Biological Animations</i>
8.	Gilles Dieumegard	<i>De-symbolization in Learning a New Symbolic System</i>
9.	Mar Mateos, Isabel Solé, Nuria Castells, Jara González Lamas	<i>The Role of Epistemological Beliefs and Reading Beliefs in Multiple Text Comprehension</i>
10.	Ulrike Magner, Rolf Schwonke, Inga Glogger, Alexander Renkl	<i>What Features Make Decorative Illustrations Interesting?</i>
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13.	Raquel Fidalgo, Olga Arias, Mark Torrance, Thierry Olive, Rui Alves	<i>On-Line Assessment of Students' Global Reading Strategies through Triple Task Technique</i>
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18.	Eniko Bezdán, Liesbeth Kester, Paul Kirschner	<i>The Influence of Annotation in Graphical Organizers</i>
19.	Sachiko Kiyokawa, Yotan Kura, Yuri Uesaka, Emmanuel Manalo	<i>Does Construction of Diagrams Deepen Understanding by Raising Awareness of Insufficiency in Learning?</i>
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21.	Marion Geiger, Markus Vogel, Tina Seufert	<i>What do Representations Say? An Analysis of Students' Verbalizations</i>
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Effects of Simplified Ancillary Representations and Cues on Learning from Animation

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Abstract. Effects of novel presentation formats on learning from animation were tested in 2 experiments. Experiment 1 recruited Johnson Laird's notions about simplification in mental model building and compared sequential combinations of different formats (static and animated) versus repeated presentation of single formats. Comprehension measures indicated that despite participant's mental model quality being significantly higher for the static-animated sequence, mental model scores were relatively low. Experiment 2 aimed to raise mental model quality by adding a new form of entity cueing in which functionally important aspects were cued via coloured tokens. Although eye movement data indicated the cues were effective in directing learners' attention they did not result in further improvements in mental model quality.

Keywords: animation, mental model building, simplified representation, token cueing, eye tracking

Introduction

Building high quality mental models from an external animation can be a demanding activity. Johnson-Laird (1998) argued that to be effective, mental models need to be "simplified representations" or "small-scale models" of the external world. Accordingly, some of the difficulties learners have in building effective mental models from animations may arise because they fail to simplify or scale down the referent content before attempting to internalize it. The two experiments reported here examined whether the chaining of simplified external representations to animated presentations and the application of cues fostered building of more effective mental models. Simplified formats such as static pictures or animation segments depicting key steps of an animation have been used in previous studies (Kriz & Hegarty, 2007; Arguel & Jamet, 2008; Bétrancourt & Morand, 2010). However, when such ancillary representations were presented in isolation or simultaneously with the animation, the results were inconclusive. It may be that these approaches lack sufficient links between the simplifications and the animations or impose excessive processing demands on the learner. We took an alternative two-stage approach to presenting simplified external representations which manipulated the presence and the temporal location of (i) a set of static pictures and (ii) the corresponding animation. A complex animation of an upright piano mechanism was used without text (Figure 1). Four pairings of presentations were compared. In the first condition (SA), a set of six Static pictures (S) depicting key steps of the mechanism was presented and then followed by the Animation (A). In the second condition, the presentation order was reversed (AS). The two other conditions were single format controls (SS and AA). Higher quality mental models were predicted in the SA, and to a lesser extent in the AS conditions, than in the single format conditions. In the SA condition, we expected that in the first stage, learners would build a mental model of the mechanism's operation by making inferences between the static key steps via active comparison and mental manipulation of pictures in the set. In the second stage, learners would use the animation as feedback for checking and refining this mental model. In the AS condition, learners could apply the mental model built from the animation to help them infer the changes depicted in the static pictures. Although this would allow them to try-out the mental model they constructed from the animation, the static pictures would be less useful for checking and refinement. In the single format conditions, there are no such opportunities to test the first-stage mental model against an alternative representation.

Experiment 1

After testing for spatial abilities and prior knowledge, the 82 participants (undergraduate French students) were randomly assigned to four groups (two dual-format and two single-format conditions). Each participant studied how the piano mechanism worked from the depictions provided (Fig. 1) for a total learning time of 3'30", (1'45" for each stage). A local motion post-test measured recall of the local motion

of each piano component. In this test, learners used the computer mouse to move crosses on a static picture of the mechanism to show the direction and amplitude of each component's movement. A second post-test, in which participants were asked to write an accurate explanation of the piano mechanism's functioning, measured the level of integration of the "conceptual model" they had developed. Comprehension scores are presented Table 1a.

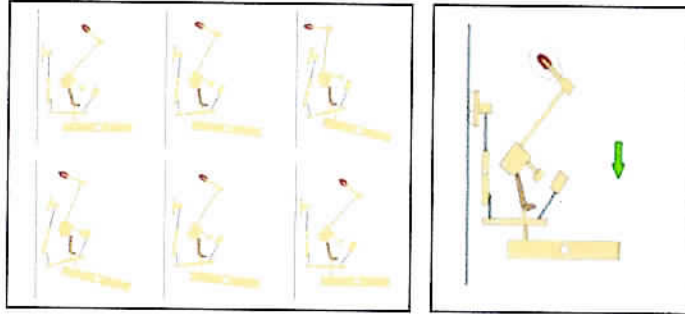


Figure 1. Series of static pictures and animation (SA) (Experiment One)

A repeated measures ANOVA showed mainly a significant interaction between type of presentation and post-test, $F(3, 78) = 6.52, p < .001, \eta_p^2 = .20$ favouring the SA and the AS conditions for the conceptual model measure only. Univariate analysis showed an effect of presentation type for the conceptual model score, $F(3, 74) = 4.44, p = .006, \eta_p^2 = .15$, with scores for SA and AS being higher than those for SS and AA, $F(1, 74) = 10.01, p = .002$. However, there was no effect of presentation type for local motion scores, $F(3, 74) = 0.85, ns$. Finally, local motion scores were higher than conceptual model scores $F(1, 74) = 290.05, p < .001, \eta_p^2 = .79$.

Experiment 2

Experiment 1 showed participant's integrated conceptual model was significantly higher for the dual format presentations than for the single format presentations. However, even in the best condition (SA), conceptual models scores were relatively low (Table 1). In experiment 2, entity-based cueing was used with the aim of directing learner's attention to specific areas with particular relevance for building high quality conceptual models. A novel form of dynamic cueing (see Boucheix & Lowe, 2010 and also the review by De Koning & al., 2009) was adapted for simplified representations by localizing cueing in functional groups of mechanism entities using coloured *tokens* (Fig. 2). The use of such tokens across key steps of the dynamic process could further improve the quality of conceptual models resulting from the chaining of simplified representations and animations.

Participants were 89 French undergraduate students. The experimental conditions and post-tests were the same as in experiment 1, except for the use of token cues, addition of a control condition without cues, and inclusion of eye tracking measures (Tobii 120). Based on the experiment one results, we choose the SA condition as the un-cued control condition for experiment 2. The same set of six static pictures was replicated four times, with each replica cueing a different functional group in its own colour. These displays were presented for 26 seconds per screen. The cue presentation order was consistent with the progressive changing dynamics of the piano operation (1: green, key-whippen; 2: red, jack-hammer butt; 3: blue, damper-hammer and 4: yellow, balance-back check.).

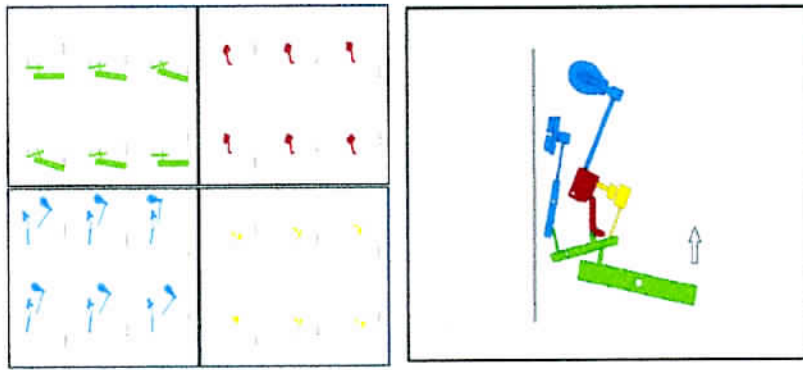


Figure 2. An example of SA condition (Experiment 2)

Table 1a, and 1b- Mean score as percentage of correct answers (and SD), for local motion and mental model quality tests, for each type of presentation, table 3a experiment 1, and table 3b experiment 2.

1a, Exp. 1	SA	AS	SS	AA	1b, Exp. 2	SA	AS	SS	AA	Control
Local Motion	41.8 (14.9)	38.8 (13.9)	42.2 (8.01)	45.6 (13.4)	Local Motion	46.2 (7.6)	47.7 (9.9)	45.8 (12.0)	49.3 (9.9)	50.3 (13.8)
Conceptual Model	24.8 (12.8)	20.8 (15.7)	16 (9.41)	13.3 (9.7)	Conceptual Model	38.9 (13.7)	40.6 (16.6)	35.2 (17.9)	43 (15.2)	35.3 (12.5)

Comprehension scores are presented table 1b. A repeated measures ANOVA showed no significant effect of presentation type, $F(4, 79) = 1.2, p = 0.3, \eta_p^2 = .05$, and no significant interaction. There was no significant difference between the groups in the cued SA and un-cued control conditions for the both post-tests, $F(1, 79) < 1, ns$. Analysis of eye movement data showed that participants looked significantly more often and longer at areas with tokens than at the rest of the display. Fixations on these areas persisted from when the token cue appeared until its disappearance indicating that the cueing directed the learner's attention efficiently (despite not resulting in comprehension benefits).

Conclusion

The addition of a simplified external representation chained to an animation resulted in superior conceptual model quality. No further benefit was obtained by adding entity-based token cueing. A possible explanation for this lack of benefit is that although these cues are effective in directing attention to an animation's functionally relevant entities, they fail to signal the key events that relate these entities and are crucial for the building mental models. However, the absolute values for conceptual model seem different between experiments 1 and 2, although the SA condition in exp. 1 and the SA control in exp. 2 were the same. Since cueing had no effect, one would expect to replicate findings from Exp. 1 in Exp. 2. Further research is needed to better understand such inconsistency.

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